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Prompt Fission Neutron Spectra and Angular Distributions Measured in Narrow Windows of Fragment Masses and Total Kinetic Energies: A Puzzling Result and a Possible Explanation

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A previous experiment performed at JRC-Geel on prompt fission neutrons (PFN) in correlation with fragments from spontaneous fission of 252Cf was repeated using an improved setup and much better statistics. The experiment lasted 3 months and 68×106 coincident events were collected. In this new experiment PFN spectra and angular distributions (in the laboratory system) are selected in a narrow window of fragment masses and total kinetic energies around AL=109 and TKE=184 MeV, AL=120 and TKE=193.5 MeV, AL=109 and TKE=184 MeV. In this way we have isolated (as good as possible) certain fission paths which makes comparisons with theoretical models easier.

Clear deviations from a Maxwellian spectrum were found from 0.5 to 6 MeV. They consist in structures, more pronounced around the most probable energy (≈1 MeV). There is a resemblance with the deviations predicted by the dynamical scission model, which assumes that PFN are emitted during the separation of fragments at scission. Concerning the angular distribution, deviations from a smooth curve are observed in the form of fine structures. They could be the sign of scattering of neutrons on the just born fragments.

Finally, oscillations are shown to be present also in the inclusive angular distribution since the sample of events over which the summation is done is not large enough to completely wash out the structures.

At first look, these identified structures in the data are not compatible with the traditional hypothesis that PFN are evaporated from fully accelerated fragments, because this hypothesis predicts smooth distributions

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